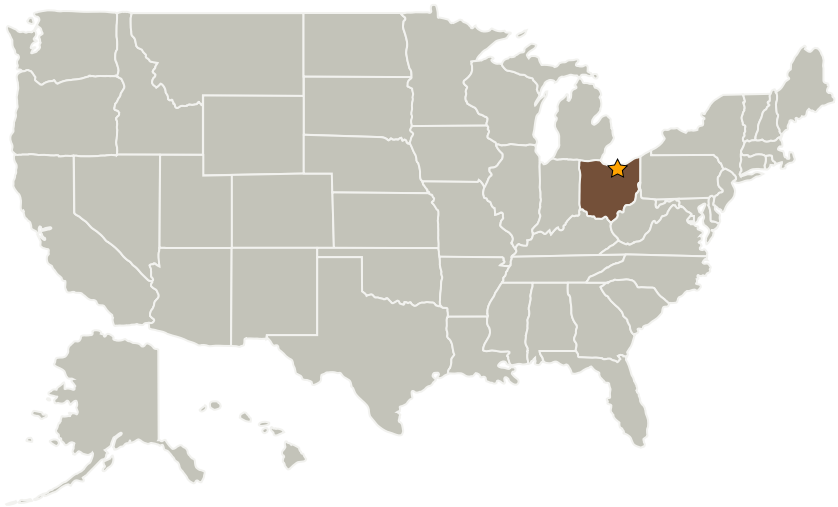
High Efficiency Quantum Dot III-V Thermophotovoltaic Cell for Space Power, Phase II

Completed Technology Project (2005 - 2007)

Project Introduction

For NASA deep space science missions, radioisotope thermoelectric generators (RTG) fueled by plutonium-238 are used to provide on-board source of heat, which is then converted to electricity. At present, NASA uses 8% efficient thermoelectric conversion systems. Compound semiconductor thermophotovoltaic (TPV) cells provide an attractive alternative. The highest efficiency TPV cell reported is a 23.6% (radiator at 1039?C, cell at 25?C) InGaAs monolithically interconnected module (MIM) on InP. We proposed an InGaAs TPV cell which incorporates InAs quantum dots to provide sub-gap absorption thus improving its short-circuit current. This cell could then be integrated into a MIM to achieve a TPV cell whose efficiency would significantly exceed (by about 15% to 20%) the state-of-the-art. In Phase I we demonstrated the feasibility of growing InAs quantum dots on 0.6 eV InGaAs on lattice-mismatched InP, and that these quantum dots, when inserted into the TPV cell, extend the bandedge, providing sub-bandgap absorption. In Phase II we propose to optimize the quantum dot structures to improve efficiency of the TPV cells, and integrate them into MIMs to achieve very high conversion efficiencies. Resulting higher specific power and power density of the overall power systems will be of great benefit to NASA in the form of lower launch costs and increased mission capability.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Essential Research, Inc.	Supporting Organization	Industry	Cleveland, Ohio

Primary U.S. Work Locations
Ohio

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.4 Engineering and Integrity
    - TX10.4.5 Architecture and Design of Autonomous Systems